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ABSTRACT

The evaluated program provides remediation in mathematics for students in New York City high schools. In addition to outcomes of the total program, the report addresses the efficacy of a pilot instructional component, "Using Computers to Teach Basic Skills." Thirty teachers participated in the pilot program, intended to improve students' computational and problem-solving skills and increase motivation to study mathematics. Visits, observations, interviews, questionnaires, and attendance and achievement data were used to evaluate the program. A description of the pilot program is included in the second chapter, with specifics on the teacher-training component and how the program was implemented. The third chapter summarizes the analyses of student outcomes for the Math Skills Program, in which 39,228 half-year students and 15,976 full-year students participated. In the fourth chapter, conclusions and recommendations are presented. The program was considered successful in providing training workshops and continuous refinement of pilot programs. The overall curriculum varied among classes, with some having a fixed curriculum while in others teachers developed their own curriculum materials. The number of computers available affected classroom strategies and management. Half-year students met the objectives of the Math Skills Program, but full-year students did not. (MNS)

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MATH SKILLS PROGRAM
1984-85
FINAL REPORT

OEA Evaluation Report

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MATH SKILLS PROGRAM
1984-85
FINAL REPORT

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SUMMARY

The Math Skills Program is funded by Chapter I and by Pupils with Special Educational Needs (P.S.E.N.). It provides remediation in mathematics for students who score two or more years below grade level on standardized tests or who have failed the Mathematics Regents Competency Test (R.C.T.). During the 1984-85 school year, students at nearly every New York City public high school took math skills classes.

This report addresses three performance objectives which measure the mathematics achievement of full-year and half-year math skills students. It also assesses the efficacy of training workshops and a pilot instructional component, Using Computers to Teach Basic Skills. Thirty teachers from 28 schools participated in the pilot. The computers served primarily as motivators for students to master basic skills, rather than as vehicles for them to learn computer literacy.

Teachers in the pilot program attended three all-day training workshops. The first workshop was held prior to the beginning of spring classes. It focused on ways to introduce the course and on approaches to curriculum implementation and classroom management. The second workshop allowed teachers and program staff to assess the pilot program at midterm and to share effective classroom strategies. Teachers also discussed problems specific to the pilot class: what to do with students who refused to use the computers; what to do when there are not enough computers for each student; and how to keep the focus on mathematics fundamentals, rather than on programming. The third workshop met in late June, after classes had ended. The workshop focus was on evaluating the past term's work and planning for the fall. The teachers indicated that, on the whole, using computers had been an effective student motivator. The 21 teachers who attended the final workshop filled out a questionnaire designed by Math Skills Program staff. The overwhelming majority found the training workshops useful.

The overall curriculum varied among the classes in the pilot program. Some were model A classes supplementing a credit-bearing course which had a fixed curriculum. Others were credit-bearing model B classes which adhered to Fundamentals of Mathematics or other curricula. Classes shared a focus on computer use. Almost all of the teachers developed their own curriculum material and used available textbooks as resources, rather than as classroom texts. These texts were often too difficult for program students' reading and mathematics levels. Most frequently, teachers adapted lessons from textbooks or manuals for student use. Curriculum development was an integral part of the training workshops.

The number of computers available affected classroom strategies and management. Teachers without enough computers

for each student had students work in pairs; used them as a reward for completed homework; or rotated access to them. Teachers with a single computer used it primarily for demonstration purposes. Teachers with fewer than nine computers found the number insufficient and those with nine or more found it sufficient. Teachers responding to the questionnaire observed improvement in their students' basic skills, attendance, and thinking skills.

The Math Skills Program had mixed success in meeting its central skills development objectives. Half-year students met the objective, but full-year students did not.

Based on the evaluation findings, it is recommended that:

- -A manual should be developed which is appropriate to the reading and mathematics skills levels of pilot program students.
- -Some attention should be paid to the low number of full-year students meeting the evaluation objective and appropriate steps taken to strengthen program effect.

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I. INTRODUCTION

PROGRAM BACKGROUND

The Math Skills Program provides remediation in mathematics for students who have mathematics scores two or more years below grade level or who have failed the Mathematics Regents Competency Test (R.C.T.). It has two goals: 1) to provide appropriate remedial instruction designed to enable students to score above the state reference point on the New York City High School Mathematics Test and to pass the R.C.T.; and 2) to provide the necessary resources for the improvement of remedial mathematics instruction in eligible schools through staff development, curriculum development, and implementation and dissemination of effective programs, methodologies, and instructional materials. In addition to its ongoing offerings, the Math Skills Program has periodically introduced pilot programs like Computer Literacy, Instrumental Enrichment, and Strategic Reasoning. During the 1984-85 school year, students at almost every New York City public high school took Math Skills classes. In these schools, 15,967 students participated in the program for the full year and 39,228 took part in the program for only half the year.

The Math Skills Program is funded by Chapter I and by Pupils with Special Educational Needs (P.S.E.N.). A school is eligible for federal Chapter I funds if a specified proportion of its student body either qualifies for the free lunch program or is a member of a family that qualifies for Aid to Families with

Dependent Children (A.F.D.C.); it is eligible for New York State P.S.E.N. funds if a specified proportion of its student body fails to meet certain academic standards. Program students can take a Chapter I-funded supplementary class in conjunction with a tax-levy credit-bearing class (Model A) or a P.S.E.N.-funded class which is itself credit-bearing (Model B).

Funding provides for teachers, educational assistants, coordinators, textbooks, and equipment. It also provides for administrative staff and staff development specialists (S.D.S.s). The program is centrally administered. S.D.S.s visit participating schools at least twice a month to train and assist teachers, distribute curriculum materials, and collect data. They also provide staff development workshops for new and out-of-license Chapter I/P.S.E.N. teachers.

PROGRAM OBJECTIVES

The Math Skills Program has two performance objectives:

- Seventy percent of the full-year program participants will evidence a difference between pre-test and post-test Normal Curve Equivalent (N.C.E.)* scores;
- Seventy percent of less than full-year program participants will master one skill for every 20 days of instruction as measured by the Math Skills Program Criterion-Referenced Test (C.R.T.).**

This evaluation also focuses on a pilot component of the program, Using Computers to Teach Basic Skills. This evaluation

*N.C.E. scores indicate a student's grade level relative to a representative sample of students in the nation.

**C.R.T.s include questions arranged in a sequence of increasing difficulty. Scores indicate the level of skill a student has

achieved in a specific subject area.

This report addresses the objective related specifically to the implementation of this pilot:

-To provide training workshops and continuous refinement for all pilot programs.

SCOPE OF THE EVALUATION

The evaluation includes two kinds of data: information about the pilot program and student outcome data. The focus of the narrative portion of this report is the implementation of a pilot program, Using Computers to Teach Basic Mathematics Skills. Thirty teachers from 28 schools participated. Five of these schools are vocational-technical high schools; two are schools for pregnant girls; the rest are academic-comprehensive high schools.

The program is intended to improve students' computational and problem-solving skills and to increase their motivation to study mathematics. The computers serve primarily as motivators for students to master basic skills, rather than as vehicles for them to learn computer literacy. Teachers can adapt the program to classrooms with differing numbers of computers. Schools can offer it in Model A or Model B classes.

EVALUATION PROCEDURES

The O.E.A./H.S.E.U. used a number of qualitative and quantitative methods in evaluating the 1984-85 Chapter I/P.S.E.N. Math Skills Program. These tools and techniques included:

-Visits to 14 classes at seven schools.
-Observations of two of the three centrally-held, all-day training sessions.

-Interviews with teachers, staff development specialists, and other central- and school-based staff to determine staff responses to program modifications.

-Questionnaires administered by the Math Skills Program to ascertain teacher response to its training sessions and teacher perceptions of the overall pilot program.

-Analyses of quantitative data, including attendance and achievement.

SCOPE OF THIS REPORT

The O.E.A./H.S.E.U. report of the 1984-85 Chapter I/P.S.E.N. Math Skills Program evaluation consists of two volumes. This volume contains four chapters. Chapter I includes program background, scope of the evaluation, and evaluation procedures. Chapter II is a description of the Using Computers to Teach Basic Skills pilot program. Chapter III summarizes the analyses of student outcomes for the Math Skills Program as a whole. Chapter IV contains conclusions and recommendations. The second volume, available from O.E.A./H.S.E.U., describes student outcome data by school and by grade.

II. PROGRAM IMPLEMENTATION

STAFFING AND STAFF TRAINING

Teachers volunteered to participate in the pilot project. Staff included both experienced and new teachers. Teachers also had varying degrees of familiarity with computers. Only four, for example, were familiar with the workings of database programs.

Staff from the Math Skills Program placed great importance on staff training. S.D.S.s held on-site meetings every two weeks with participating teachers; the S.D.S.s shared curriculum, did model lessons, and discussed issues related to the implementation of the pilot program. In addition, the program required teachers of the pilot classes to attend three all-day training workshops.

The Math Skills Program held the first workshop at the end of January, prior to the beginning of spring classes. Thirty-five teachers from 23 schools attended. The Director of Mathematics from the Office of Curriculum and Instruction during the 1984-85 school year described the pilot philosophy; he had worked with the Math Skills Program in developing the Using Computers pilot. The S.D.S.s discussed ways to begin the course. They provided the teachers with

several sample lessons designed to introduce students to such topics as a computer's parts and their functions, the computer as calculator, and computer programming. S.D.S.s and teachers also focused on curriculum implementation, particularly curriculum outline, lesson plans, and classroom management.

The second workshop took place at the end of March, with 35 teachers attending. The workshop allowed teachers and program staff to engage in a midterm assessment of the pilot program. Teachers shared ways they had addressed the students' fear of computers: one teacher allowed students to "play" with the computer in order to overcome their fears; another set up colorful programs with lots of graphics at the beginning; and a third had students spend the first week drawing pictures. Teachers also discussed various classroom management problems: what to do with students who refused to use the computers; what to do when there are not enough computers for each student; how to keep the focus on mathematics fundamentals, rather than on programming. The teachers then worked in pairs to write lesson plans on different topics. They subsequently received and discussed a xeroxed packet of these lessons. An S.D.S. showed a 20-minute videotape he had made of a lesson given by a teacher who was in his first year of teaching and lacked any computer background. The S.D.S. offered all teachers in the pilot

program the option of having a lesson videotaped; they could then use the videotape as a means of evaluating and assessing their teaching skills.

The third workshop took place at the end of June, after classes had ended, 22 teachers attended. The workshop focused on assessing the past term's work and planning for the fall. The teachers indicated that, on the whole, using computers had been an effective student motivator. However, several teachers found that, after a significant initial increase in interest, some students had lost interest in doing computations or straight programming. One teacher addressed this problem by using the computer's graphic capability to add a visual dimension to students' work with formulas; another teacher switched to computer assisted instruction (C.A.I.) so that students could work individually at their own pace. A few teachers noted that they had stopped using the computers a month or more before the end of the term so that they could concentrate on preparing students for the R.C.T. Several teachers continued to have difficulty getting access to their schools' computer rooms or to more than one or two of the computers available at their schools. These teachers did, however, expect to benefit from the creation in September, 1985 of two or more computer rooms in every high school. They anticipated having greater access to computers during the 1985-86 school year. Teachers suggested

exchange visits for program teachers and a session on minor computer repairs as useful fall activities. In addition to engaging in the open discussion about the pilot program, teachers spent part of the session writing and discussing lesson plans which they could use in the fall. At the end of the training workshop, they filled out an extensive questionnaire designed by the Math Skills Program staff.

The 21 teachers who filled out the evaluation questionnaire overwhelmingly found the training workshops useful. Teachers rated specific aspects of the workshops on a scale ranging from one to five, with five indicating most useful. According to these ratings, teachers found the workshops (4.4), the roundtable discussions (3.8), the review of the BASIC programs (3.9), and the time set aside for planning the lessons (3.2) all generally useful. The majority found sharing with others the most useful aspect of the workshops. Eighty-four percent of the respondents thought that the Math Skills Program held the training workshops often enough.

CURRICULUM

The overall curriculum varied among the classes in the pilot program. Some were model A classes supplementing a

credit-bearing class which had a fixed curriculum. Others were credit-bearing model B classes which adhered to the required Fundamentals of Mathematics or other curriculum.

Classes shared a focus on computer use. Teachers did not use the same computer textbook or manual. All did, however, have copies of Using Computers in Teaching Basic Mathematics by Gerald Elgarten and Alfred Posamentier. The book was used more as a resource than as a textbook. At two training workshops, S.D.S.s had teachers develop lesson plans based on material from two of the book's chapters. Forty-seven percent (N=17) of the respondents found the book of some use in planning lessons. Eighty-eight percent (N=17) said that the textbook was not of use to the students. Only two of the ten teachers whose classes were observed were using it as an assigned textbook. Teachers and S.D.S.s agreed that this text was too advanced for program students' reading and mathematics levels.

Nearly all teachers developed their own curriculum materials. Most frequently, they adapted lessons from textbooks or manuals for student use. Curriculum development was an integral part of the training workshops. At least two hours of the last two workshops were devoted to teacher development and discussion of lesson plans appropriate to program students. At Mabel Dean Bacon, the assistant principal for mathematics developed 16 lesson plans to be

used by the three pilot program teachers at her school; topics included using the computer, multiplication and division, numeric and string variables, and perimeters.

CLASSROOM IMPLEMENTATION

The number of computers available to each teacher affected both classroom management and classroom strategies. More than half of the teachers in the program had fewer than nine computers, as did more than half of the ten teachers observed. Teachers had access to these computers once or twice a week.

Teachers at two of the schools visited by the evaluation team had enough computers for their entire classes. At Eastern District, students in two classes worked individually to enter the program and solve the problem on the computer; they then did the computation with pencil and paper. At John Bowne, one of the two program teachers had students work in pairs even though she had access to enough computers for each student; she felt that such collaboration increased student involvement in the assigned work.

Teachers with fewer computers also adopted different strategies for using them in the classroom. At Erasmus, for example, a teacher with 12 computers used them as a reward

for students who did their homework; he reported that this approach effectively motivated students. At Mabel Dean Bacon, a teacher with eight computers assigned two or three students to each; one student would work on the computer while the other one or two observed; the students rotated the following week. On the day of the site visit, however, attendance in two Mabel Dean Bacon classes was low enough to allow each student access to a computer.

Teachers with only a single computer in the classroom used it primarily for demonstration purposes. At Art and Design, for instance, the teacher organized each topic into a three-class block of time: a lecture, a demonstration lesson with written assignment, and a follow-up lesson. Most often, the teacher did the demonstration; sometimes he had one or two students do it. At John F. Kennedy High School, a teacher who usually runs her class as a mathematics laboratory brought in a computer on the day of the site visit and used it to introduce students to its parts and functions. At Sarah J. Hale, a teacher with only one computer used it as a reward.

According to the responses to the evaluation questionnaire, teachers with fewer than nine computers found the number insufficient; it was easier to engage students if there were nine or more computers. At Sarah J. Hale, for example, the evaluator got very different responses from the

teachers of two classes. The teacher of the classes with a single computer noted that only the few students who get to use it were actively involved in the lesson. The teacher with access to twelve computers, however, saw a big improvement in student performance as a result of their ongoing work with the computers.

Teachers responding to the questionnaire reported that their students had made gains in several major areas. All respondents observed improvement in their students' basic skills. Nearly 90 percent observed improvement in their students' attendance. Over 85 percent observed improvement in their students' critical thinking skills.

III. STUDENT OUTCOMES

RESULTS FOR HALF-YEAR STUDENTS

A total of 39,228 half-year students participated in funded math skills classes. Of these students, 44 percent (17,289) were in the ninth grade, 35 percent (13,604) in the tenth grade, 14 percent (5,706) in the eleventh grade, and six percent (2,191) in the twelfth grade. A slightly higher percentage of students (50 percent) were in Model A classes than in Model B classes (47.5 percent).

On the average, half-year students attended 73 percent of program classes (80 days in the fall term and 75 days in the spring term). Two-thirds of these students had complete C.R.T. test results as measured by the New York City Mathematics Test. These students attended an average of 82 percent of program classes.

To meet the program's evaluation objective, at least 70 percent of students in the program for less than a year had to master one new reading skill for every 20 days of instruction. Half-year students in grades nine through twelve surpassed this program objective. Approximately 83 percent of half-year students met the evaluation objective, mastering an average of 7.9 skills (S.D.=7.1).

The percentage of those who met the evaluation

objective during the 1984-85 school year was slightly higher than it was during the 1983-84 school year (80 percent). The number of skills mastered, however, remained constant.*

RESULTS FOR FULL-YEAR STUDENTS

Data were received for 15,967 students. Of these full-year students, 53 percent (8,508) were in the ninth grade, 32 percent (5,090) in the tenth grade, 11 percent (1,704) in the eleventh grade, and three percent in the twelfth grade. A slightly higher percentage of students were in Model A classes (53 percent) than in Model B classes (44 percent).

Complete test results were obtained for 83 percent of the students. Average attendance was 84 days for all full-year math skills students out of a possible 121 days (the period of time between the October pretest and the May posttest). Those with complete results attended 70 percent of the time.

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*The change in the percentage of students who met the evaluation objective reflects a change in O.E.A./H.S.E.U. methodology. A review of previously-used methods of data analysis revealed that they understated the number of students who met the evaluation objective. The subsequent methodological revision more accurately reflects student achievement. For example, a student enrolled for 63 out of a total of 75 days would be expected to master three objectives under the new system, but 3.5 objectives under the old system.

To meet the performance objective, 70 percent of full-year students had to evidence a gain in their posttest N.C.E. scores over their pretest scores. Of students with complete test results, 45 percent met the evaluation objective by showing an improvement in N.C.E. units. The percentage of students meeting the objective ranged from 44 percent in the ninth and tenth grades to 48 percent in the eleventh grade. On the whole, students showed a decrease of 1.2 N.C.E. units (S.D.= 17.8). Statistically, this amounts to no change (effect size=.004 to .08).*

On average, students who met the objective attended for 93 days. Those who did not meet it attended for an average of 78 days. The worst attendance was among ninth graders in both groups. Twelfth graders who failed to meet the objective attended approximately the same number of days as those who met it.

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*Effect size (E.S.), developed by Jacob Cohen, is the ratio of the mean gain to the standard deviation of the gains. This ratio provides an index of change in standard deviation units regardless of the size of the sample. According to Cohen, 0.2 is a small E.S.; 0.5 is a moderate E.S.; and 0.8 is a large E.S. Only effect sizes of 0.8 and above are considered educationally meaningful.

IV. CONCLUSIONS AND RECOMMENDATIONS

The Math Skills Program was successful in meeting the program objective related to the Using Computers to Teach Basic Skills pilot component: to provide training workshops and continuous refinement for all pilot programs. S.D.S.s held regular on-site meetings with participating teachers. The program also required teachers of the pilot classes to attend three all-day training workshops. Teachers from 28 high schools taught pilot classes during the spring term.

Teachers in the program attended three training workshops. The first workshop was held prior to the beginning of spring classes. It focused on ways to introduce the course and on approaches to curriculum implementation and classroom management. The second workshop allowed teachers and program staff to assess the pilot program at midterm and to share effective classroom strategies. Teachers also discussed problems specific to the pilot class: what to do with students who refused to use the computers; what to do when there are not enough computers for each student; how to keep the focus on mathematics fundamentals, rather than on programming. The third workshop met in late June, after classes had ended. The workshop focus was on evaluating the past term's work and planning for the fall. The teachers indicated that, on the whole, using computers had been an

effective student motivator. The 21 teachers who attended the final workshop filled out a questionnaire designed by Math Skills Program staff. They overwhelmingly found the training workshops useful.

The overall curriculum varied among the classes in the pilot program. Some were model A classes supplementing a credit-bearing class which had a fixed curricula. Others were credit-bearing model B classes which adhered to Fundamentals of Mathematics or other curriculum. Classes shared a focus on computer use. Almost all of the teachers developed their own curriculum material and used available textbooks as resources, rather than as classroom texts. These textbooks were often too difficult for program students' reading and mathematics levels. Most frequently, teachers adapted lessons from textbooks or manuals for student use. Curriculum development was an integral part of the training workshops.

The number of computers available affected classroom strategies and management. Teachers without enough computers for each student had students work in pairs; used them as a reward for completed homework; or rotated access to them. Teachers with a single computer used it primarily for demonstration purposes. Teachers with fewer than nine computers found the number insufficient and those with nine or more found it sufficient. Teachers responding to the evaluation questionaire observed improvement in their

students' basic skills, attendance, and thinking skills.

The Math Skills Program had mixed success in meeting its central skills development objectives. Half-year students with complete results met the reading objective, but full-year students with complete test results did not.

Based on the evaluation findings, it is recommended that:

1. A manual should be developed that is appropriate for the reading and mathematics skills levels of pilot program students.
2. Some attention should be paid to the low number of full-year program students meeting the evaluation objective and appropriate steps taken to strengthen program effect.